

Correlation and Prediction of the Solubility of CO₂ in Aqueous Solutions of N-Methyldiethanolamine + Piperazine

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Solubility data of CO₂ in 2.52, 3.36 and 4.28 kmol/m³ aqueous N-methyldiethanolamine (MDEA) solutions were obtained at temperatures of 40, 55 and 70°C and partial pressures ranging from about 30 to about 5000 kPa. A thermodynamic model based on extended Debye-Hückel theory was used to predicting and correlation of CO₂ solubility in various aqueous amine solutions. The effect of Piperazine (PZ) concentration on CO₂ loading in MDEA solutions was determined at PZ concentration of 0.36, 0.86 and 1.36 kmol/m³. Using experimental data in various temperatures the interaction parameters for these systems were determined. The results show that the model consistency with experimental and literature data, and PZ is beneficial to the CO₂ loading. The effect of Piperazine on solubility of carbon dioxide was studied and the results show that Piperazine is profitable to the carbon dioxide loading in MDEA solutions. A comparison of results of this study with previous data work shows the wide range of CO₂ loading considered in this work and the better agreement of model with equal experimental data [1]. The average absolute deviations (AADs) for all data points were 8.1145%.

The solubility measurements were carried out in a modified autoclave reactor. The reactor consists of a 1 liter stainless steel cylindrical tank with a magnetically coupled stirrer on the top (Parr, 4842). A thermocouple was inserted in the autoclave to determine the temperature with an accuracy of 0.1 K. The pressure of autoclave is measured by a pressure transmitter (Druck, PTX 1400) with an accuracy of 0.7 kPa. The composition of the liquid is analyzed by a gas chromatograph (Varian, 3800) using the FID detector and 10 m × 0.5 mm DB-WAX column. Details of experimental procedure are given in our previous work [2].

- [1] Liu H. -B., Zhang C. -F. and Xu G. -W., A study on equilibrium solubility for carbon dioxide in Methyldiethanolamine-piperazine-water solution, *Ind. Eng. Chem. Res.* **38**, 4032-4036 (1999).
- [2] Hosseini Jenab M., Abedinzadegan Abdi M., Najibi S. H., Vahidi M. and Seyed Matin N., Solubility of CO₂ in aqueous solutions of N-methyldiethanolamine piperazine sulfolane, *J. Chem. Eng. Data.* **50**, 583-586 (2005).